Practical Training for Instrument and Control Engineers

1. Background

This course mainly provides coherent, hands-on practical training in a wide range of fields, from basic technologies to applied engineering. It is intended for engineers in the instrumentation and control fields, which are two fields that differ from each other but have a strong mutual relationship.

To provide knowledge that would allow participants from varying fields to have a wide perspective and benefit them in the future, the participants were restricted to relatively young engineers in their early 30s and below, and the length of the course was extended to 32 days.

At Yokogawa Electric, a field instrument manufacturer

2. Program Overview

2.1 Basics of instrumentation and control

(1) Overview of refinery information systems

A lecture was given on the configuration of the PIS (Plant Information System) and PCS (Process Control Systems) in refineries, and their relevant systems and application to the management of operations. (Lecture at JCCP)

Additionally, a visit was made to a refinery to witness examples of the application of such information systems. (Offsite training at JX Nippon Oil & Energy's Marifu Refinery)

(2) Comprehensive lecture on DCS (Distributed Control System) and related devices

Comprehensive knowledge was provided on the latest DCS functions and devices, including the fieldbus, which is the latest in instrumentation technologies, in reference to actual devices. (Offsite training at the headquarters of Yokogawa Electric Corporation)

(3) Process control theory

Through hands-on training using CAI (Computer-Assisted Instruction) facilities, knowledge was provided on an overview of PID (Proportional-Integral-Derivative) control, which forms the foundation of control theories, and tuning methods. The participants also engaged in practical training on deriving parameters from simulator responses. (Lecture and practical training at JCCP)

(4) Management of instrumentation devices

A lecture was given on an overview of the principles and structure of control valves, flow meters, online analyzers and vibration sensors, and their inspection and management. Following the lecture, the participants learned about the structure and safe inspection of instrumentation devices through hands-on training in the disassembly, inspection and reassembly of actual devices and instruments. (Offsite training at Azbil Corporation, Shonan Factory; Oval Corporation, Yokohama Office; DKK-Toa Corporation, Tokyo Engineering Center; and Shinkawa Sensor Technology, Inc., Hiroshima Works)

Practical training in the disassembly and inspection of a control valve

Practical training in the disassembly and inspection of a flow meter

DCS engineering practice

(5) Wireless instrumentation systems

Comprehensive knowledge was provided on the basic technology, application and general design of wireless instrumentation devices, which are being increasingly introduced in recent years, through lectures accompanied by hands-on training. Visits were also made to sites that have actually introduced wireless instrumentation systems, where active Q&A took place on matters that were taken into consideration when deciding to introduce a system, and on the operation and management of such systems. (Offsite training at Yokogawa Electric Corporation, Hiroshima Branch Office and Tokuyama Corporation)

Practical training at a wireless instrument manufacturer

2.2 Instrumentation and control applications

(1) DCS engineering

A lecture on the overview and specific design method of the DCS shutdown logic design was followed by a hands-on workshop, in which each participant drew a logic flow, entered it into a DCS and verified whether the sequence they had designed operated as intended. (Offsite training at Azbil Corporation, Fujisawa Techno Center)

(2) Safety instrumentation system

Following a lecture on the general description of safety instrumentation systems, which are currently being introduced on a global scale, practical training was provided on the analysis of accidents using the SIL (Safety Integrity Level) basic calculation method and HAZOP (Hazard and Operability Study) method through group discussions in reference to actual examples. (Lecture and practical training at JCCP)

(3) Model-based predictive control

Following a lecture on the general description of MPC (Model-based Predictive Control), which represents the latest in DCS technologies, hands-on training was provided in using MPC to control the flow rate of steam in a PC simulator. Furthermore, the DCS was connected to a miniature plant that actually runs water, to provide hands-on training that allows participants to actually experience MPC operation. (Lecture and practical training at JCCP)

Practical training in MPC

(4) Operation support systems

Operation support systems minimize operator burden by automating DCS operations. Following an overview of such systems and an introduction of best practices, the participants gained first-hand experience in designing an automated flow by operating an actual PC program. An operation support system was then connected to a DCS that is used to operate a miniature plant, to provide direct experience in the automation of control processes.

3. Participants

The participants comprised a group of 13 engineers from 10 countries, ranging in age from 25 to 32. At an average age of 29, the group was composed of relatively young engineers, as originally designed. However, most of the participants were engaged in operations related to instrumentation, and only few were adept at control processes.

All through the month-long training program, the participants displayed a serious, enterprising attitude, and applied themselves to their training without losing concentration. The appearance of them actively exchanging views, always standing ready with pen and paper and jotting down what they see and hear, was representative of the attitude they exhibited up to the last day. They were also frequently seen displaying thoughtful, exemplary conduct as a team, such as by teaching each other as they engaged in practical training. They were wholly hardworking, outstanding participants with a high level of professionalism.

4. Course Review

This course, which runs over a longer period than usual, as it is designed to provide a large amount of wide-ranging knowledge to instrumentation and control engineers, was implemented for the third time since beginning to be offered as a regular course.

During this time, there have been differences in opinion regarding the length of the course, and repeated trial and error has ensued, but satisfactory feedback was finally obtained from all participants of this recent course.

The course content also received high marks, but improvements will continue to be made hereafter to offer an even more effective course, by incorporating detailed opinions for improvement.

Because changes were partly made to the travel schedule due to poor weather conditions, the practical simulator training scheduled at JCCP was regrettably canceled. Nevertheless, it can probably be said that, on the whole, a satisfying course has been planned and implemented.

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